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Automatic Identification System (AIS) Transmit Testing in Louisville Phase 2

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Homeland Security

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16. Abstract (MAXIMUM 200 WORDS)

The Automatic Identification System (AIS) is an autonomous and continuous broadcast system that exchanges maritime safety/security information between participating vessels and shore stations. In addition to providing a means for maritime administrations to effectively track the movement of vessels in coastal and inland waters, AIS can be a means to transmit information to ships in port or underway that contributes to safety-of-navigation and protection of the environment using Application Specific Messages (ASMs). The United States Coast Guard Research and Development Center has developed processes to manage the ASMs. Several standard ASMs have been defined and methods have been developed for message creation, routing, queuing, transmission and monitoring. An AIS transmit architecture aligned with International standards has been developed to implement the efficient and robust transmission of ASMs. As part of the development and testing of the capability to transmit electronic Marine Safety Information (eMSI), RDC established a test bed in Louisville, KY. This report summarizes the goals and results of both the first phase conducted in 2012 and the second phase conducted July 2013 - May 2014. The tests show that the transmission of eMSI can improve safety-of-navigation and efficiency of marine transportation.

7. Key Words AIS, VTS, ASM, AIS transmit, ASM Manager, Louisville, Test Bed	**18. Distribution Statement** Distribution Statement A: Approved for public release; distribution is unlimited.		
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EXECUTIVE SUMMARY

The Automatic Identification System (AIS) is an autonomous and continuous broadcast system that exchanges maritime safety/security information between participating vessels and shore stations. In addition to providing a means for maritime administrations to effectively track the movement of vessels in coastal and inland waters, AIS can be a means to transmit information to ships in port or underway that contributes to safety-of-navigation and protection of the environment.

Since 2007, the United States Coast Guard Research and Development Center (RDC) has been working on an AIS Transmit Project to determine what additional information is required by AIS users, recommend how the information should be transmitted, and test the transmission of this information at test bed sites. This information is transmitted using AIS Application Specific Messages (ASMs). Several standard ASMs have been defined and prototype methods have been developed for message creation, routing, queuing, transmission and monitoring.

Vessel Traffic Center (VTC) Louisville is unique among VTCs due to its non-traditional operational requirements. VTC watchstanders are only required to "stand up" when the Ohio River crests above 13 feet. Due to the infrequency of this event, typical VTC sensors and hardware systems are not installed. Operators rely primarily on a network of cameras and a standard radio system. To aid watchstanders during operational events and to increase everyday maritime domain awareness in the VTC Area of Responsibility (AOR), VTC Louisville added AIS capability in 2010.

A test bed was established in Louisville in 2011 to develop and test new sources of environmental data for transmission such as river current sensors and river gauge sensors and to test the usage of the Waterways Management (WM) ASMs and assess their usefulness. This test bed was also the first to be set up using the new transmit architecture and processes. Although this provided a good test bed for developing the new architecture software, only some of the Phase I test goals were met. The biggest hold-up was the lack of fully functioning user software. This limited RDC's ability to collect feedback from the mariners on the usefulness of the messages.

In order to complete the assessment processes, the decision was made to conduct a Phase II test at Louisville. The primary goals of the second phase were to fully test the Waterways Management ASM and to assess usefulness from the mariner's point of view. To enable this, RDC has worked with two software manufacturers, CEACT and RosePoint, to get their software updated to support the decoding and display of the ASMs.

The Phase II test bed commenced operation on 1 July 2013. From the transmit side, the test bed worked well. The system was operational the majority of the time, with only minor downtimes due to computer or network problems. The automated processes to access external data, format, and queue the data for transmission all worked well. However, it proved difficult to collect a lot of feedback from the mariners for the receive side. Although CEACT and RosePoint had updated their software to support ASMs, the end users were not trained to use those features, so there was no feedback on use or benefit of receiving ASMs. The only feedback received was from meetings with users. The meeting discussions showed that the ASMs provide important information that not only improves safety-of-navigation but also helps improve efficiency in the maritime industry.

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LIST OF ACRONYMS

ADCP	Acoustic Doppler Current Profiler
AIS	Automatic Identification System
AOR	Area of responsibility
ASM	Application Specific Message
AtoN	Aids to navigation
CEACT	Channel ECDIS and Course Trajectory
DAC	Designated area code
ECDIS	Electronic Chart Display and Information System
ECS	Electronic Charting System
EM	Environmental ASM
eAtoN	Electronic aids to navigation
eMSI	Electronic maritime safety information
FATDMA	Fixed access time division multiple access
LOMA	Lock Operations Management Application
LOS	Line of sight
LPMS	Lock Performance Monitoring System
LTM	Linked text message
MMSI	Maritime Mobile Service Identity
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NTSC	National Transportation Systems Center
NWS	National Weather Service
OMNI	Operations and maintenance of navigation information
PORTS	Physical Oceanographic Real-Time System
RATDMA	Random access time division multiple access
RDC	Research and Development Center
SCI	Seaman's Church Institute
TV32	Transview (32 bit edition)
USACE	U.S. Army Corps of Engineers
USCG	United States Coast Guard
VHF	Very high frequency
VTC	Vessel Traffic Center
VTS	Vessel Traffic Service
WM	Waterways management

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1 INTRODUCTION

The Automatic Identification System (AIS) is an autonomous and continuous broadcast system that exchanges maritime safety/security information between participating vessels and shore stations. In addition to providing a means for maritime administrations to effectively track the movement of vessels in coastal and inland waters, AIS can be a means to transmit information to ships in port or underway that contributes to safety-of-navigation and protection of the environment. This includes meteorological and hydrographic data, carriage of dangerous cargos, safety and security zones, status of locks and Aids to Navigation (AtoNs), and other port/waterway safety information.

While AIS is a highly effective means of providing information to a Vessel Traffic Service (VTS) Center about vessel position and identification, it can also be used as a VTS tool for communication by utilizing the transmit capability which includes both broadcasts to all users within range and addressed messages to specific users. Since 2007, the USCG Research and Development Center (RDC) has been working to establish an AIS Transmit capability by identifying requirements, developing processes and procedures, and testing these processes and procedures in various AIS transmit test beds.

Vessel Traffic Center (VTC) Louisville is unique among VTCs due to its non-traditional VTC operational requirements. VTC watchstanders are only required to "stand up" when the Ohio River crests above 13 feet. Due to the infrequency of this event, typical VTC sensors and hardware systems are not installed. Operators rely primarily on a network of cameras and a standard radio system. To aid watchstanders during operational events and to increase everyday maritime domain awareness in the VTC Area of Responsibility (AOR), VTC Louisville added AIS capability in 2010.

2 PHASE I GOALS & RESULTS

A Phase I test bed was established in Louisville in 2011 for multiple reasons. First, VTC Louisville would be the first test bed established inland, away from a major port. Second, it has limited Line-of-Sight (LOS) VHF signal paths due to winding rivers, land mass obstructions and heavy foliage; conditions not encountered in a typical coastal port. Third, it was the first test bed where Physical Oceanographic Real-Time System (PORTS)[1] data are not available. Finally, it was a VTS that had a lock in the AOR. The goals for this test bed were:

1. Develop and test new sources of environmental data for transmission such as river current sensors and river gauge sensors.
2. Test the usage of the Waterways Management (WM) ASMs and assess their usefulness.
3. Develop and test the automatic generation of WM ASMs from U.S. Army Corps of Engineers (USACE) data sources (vessels awaiting lockage).
4. Test the usage of the Synthetic/VTS Target ASM.
5. Test the usage of telecommands and assess their usefulness.
6. Test AIS transmit effectiveness for inland waterways environments.
7. Assess the benefits of enhanced AIS for inland waterways' vessel traffic management.

The Louisville test bed was also the first to be set up using the new transmit architecture and processes. Although this provided a good test bed for developing the new architecture software, of the seven goals listed, only some were met during the Phase I test. Specifically, Goals 1 and 3 were met; message encoders

[1] http://tidesandcurrents.noaa.gov/ports.html

were developed to pull river flow and river gauge data from the USACE and airport weather from the National Weather Service (NWS). Vessel queue information from three locks (McAlpine, Cannelton, and Markland) was also transmitted using data pulled from the USACE OMNI database. Goal 2 could not be met as the user software was never completed by Channel ECDIS and Course Trajectory (CEACT) navigation software, so although messages were being transmitted, they were not decoded and displayed. CEACT is Electronic Charting Software (ECS) used by many of the vessels on the Ohio River. Goals 4 and 5 were not done due to insufficient time and lack of user software support. Goals 6 and 7 could not be fully assessed due to the lack of adequate user software.

3 PHASE II TEST BED

3.1 Goals

In order to complete the assessment processes, the decision was made to conduct a Phase II test at Louisville. The goals of the second phase were to:

1. Fully test the Waterways Management ASM.
2. Assess usefulness from the mariner's point of view.
3. Test integration/management of AIS AtoN units.

3.2 AIS Message Transmission

Table 1 contains the list of messages that were transmitted from the test bed. The reference for each message to be transmitted is also listed. Phase II started with the three ASMs and the two standard messages (Message 4 and 20).

Table 1. AIS messages to be transmitted.

Message	Source	Message Specification
Environmental ASM (EM)	NWS, USACE, Local WX station	DAC367 FI33
Waterways Management ASM (WMM)	USACE	DAC367 FI35
Linked Text ASM (LTM)	USCG AIS	DAC367 FI29
Channel Management	Base Station	AIS 20
Base Station	Base Station	AIS 4
ATON	USACE/USCG	AIS 21

3.3 ASM Data Sources

The various data sources for each message type are listed in Table 2. The Environmental ASM was automatically generated from database data by software running on the ASM Manager computer located at RDC. The lock queue (part of the Waterways ASM) was also generated automatically; using data pulled from the USACE Lock Performance Monitoring System (LPMS) database. This message was paired with a Linked Text Message to transmit the vessel name for those cases where the Maritime Mobile Service Identity (MMSI)-name pairs did not exist in the local database. The Environmental ASMs, with sources from the USACE Acoustic Doppler Current Profiler (ADCP) and the USACE lock current model, are included in Table 2, but were not tested. The AIS base station was configured to reserve slots and transmit the Base Station Information (Message 4) and the Channel Management (Message 20) AIS messages. A USACE AIS AtoN unit located at McAlpine Lock was programmed to transmit a Message 21 (AIS AtoN) at 3-minute intervals. The slots for these transmissions were reserved by the base station.

Table 2. Data types and source.

ASM	Data (report type)	Source
EM	Station # 1, McAlpine Upper, - location (0), station ID (1), water level (3), current (4) Station # 2, McAlpine Lower, - location (0), station ID (1), water level (3), current (4) Station # 4, Cannelton Upper, - location (0), station ID (1), water level (3), current (4) Station # 5, Cannelton Lower, - location (0), station ID (1), water level (3) Station # 7, Markland Upper, - location (0), station ID (1), water level (3), current (4) Station # 8, Markland Lower, - location (0), station ID (1), water level (3)	USACE database for water level Ohio River Forecast Center web site for current
EM	Station # 6, RMR Weather (near Markland), - location (0), station ID (1), wind (2), weather (9) Station # 9, Fort Knox, - location (0), station ID (1), wind (2), weather (9)	Private Davis weather station NWS
EM	Station #3, McAlpine Lock, - location (0), station ID (1), wind (2), weather (9)	Davis WX station at lock
EM	Station #11, McAlpine Lock, - location (0), station ID (1), current (4)	ADCP data from USACE
EM	Station #12, McAlpine Lock, - location (0), station ID (1), current (4)	Lock current model data from USACE
WM	Lock Queue (vessels awaiting lockage)	USACE LPMS database
LTM	Vessel name for vessels awaiting lockage when MMSI is unknown	USACE LPMS database

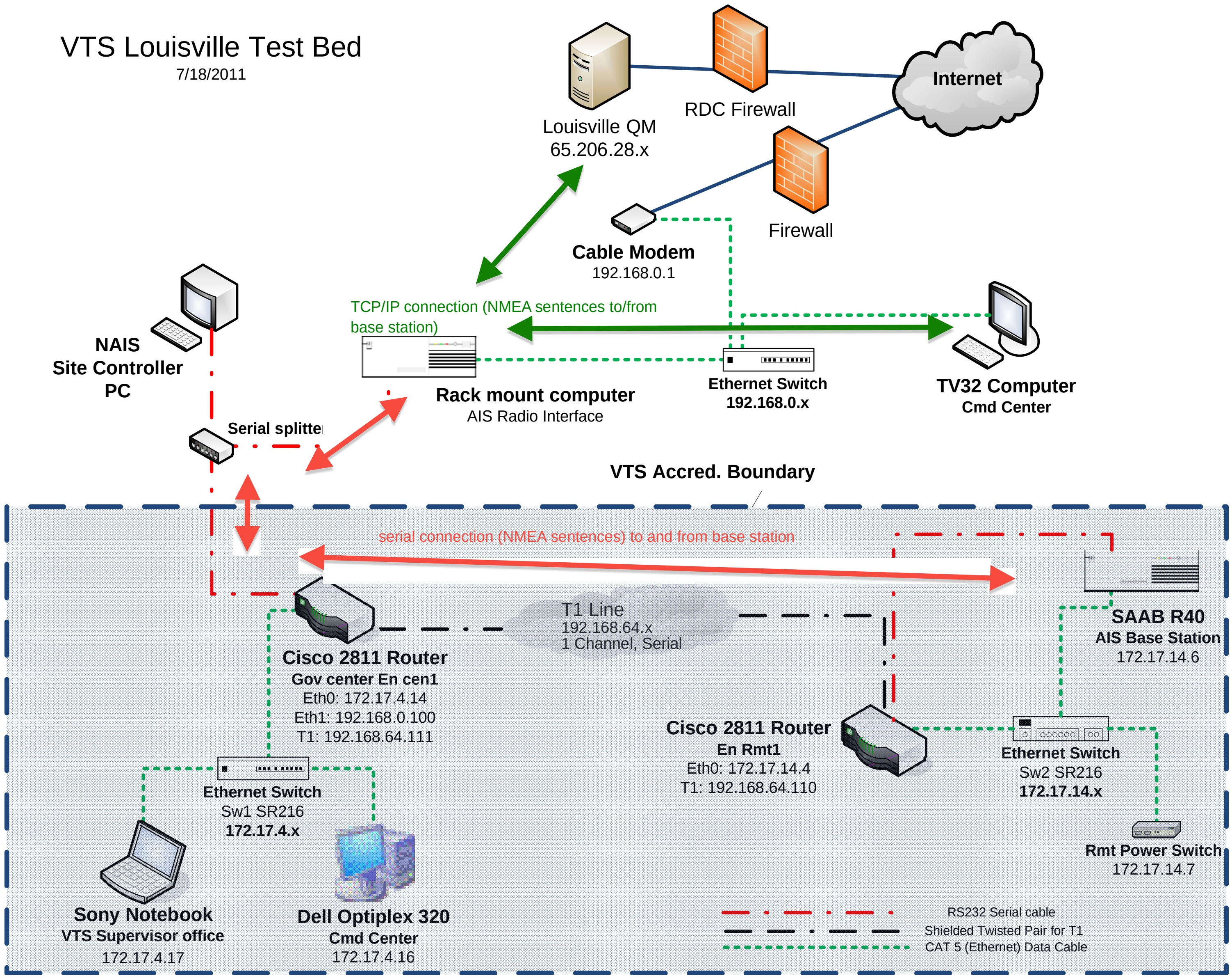

Figure 1. Louisville test bed configuration.

3.4 Test Bed Configuration

3.4.1 Network Configuration

The network configuration of the test bed is shown in Figure 1. The base station configuration for slot reservations and scheduled messages (4 and 20) is shown in Figure 2 and Figure 3, respectively.

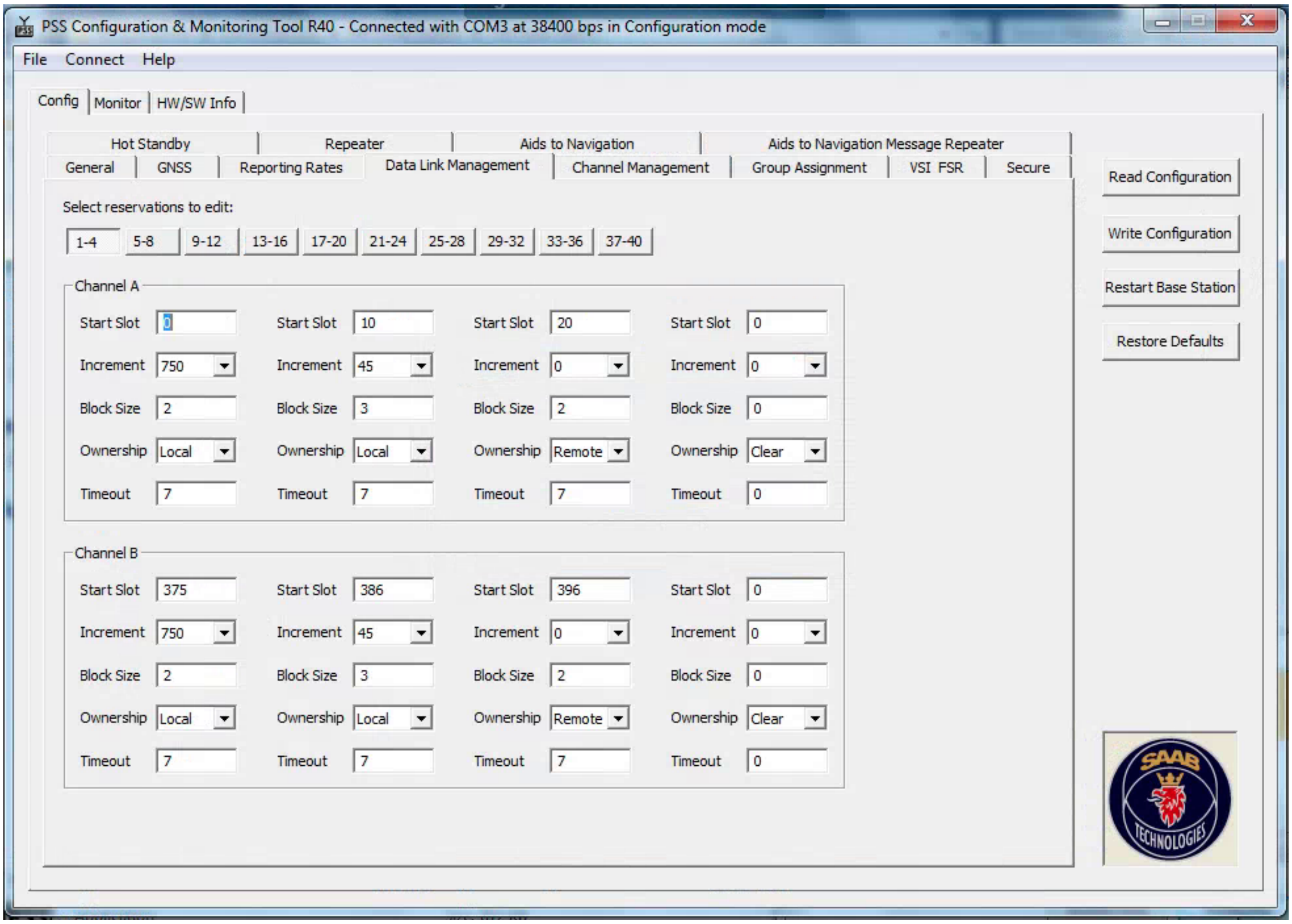

Figure 2. Louisville base station slot reservations.

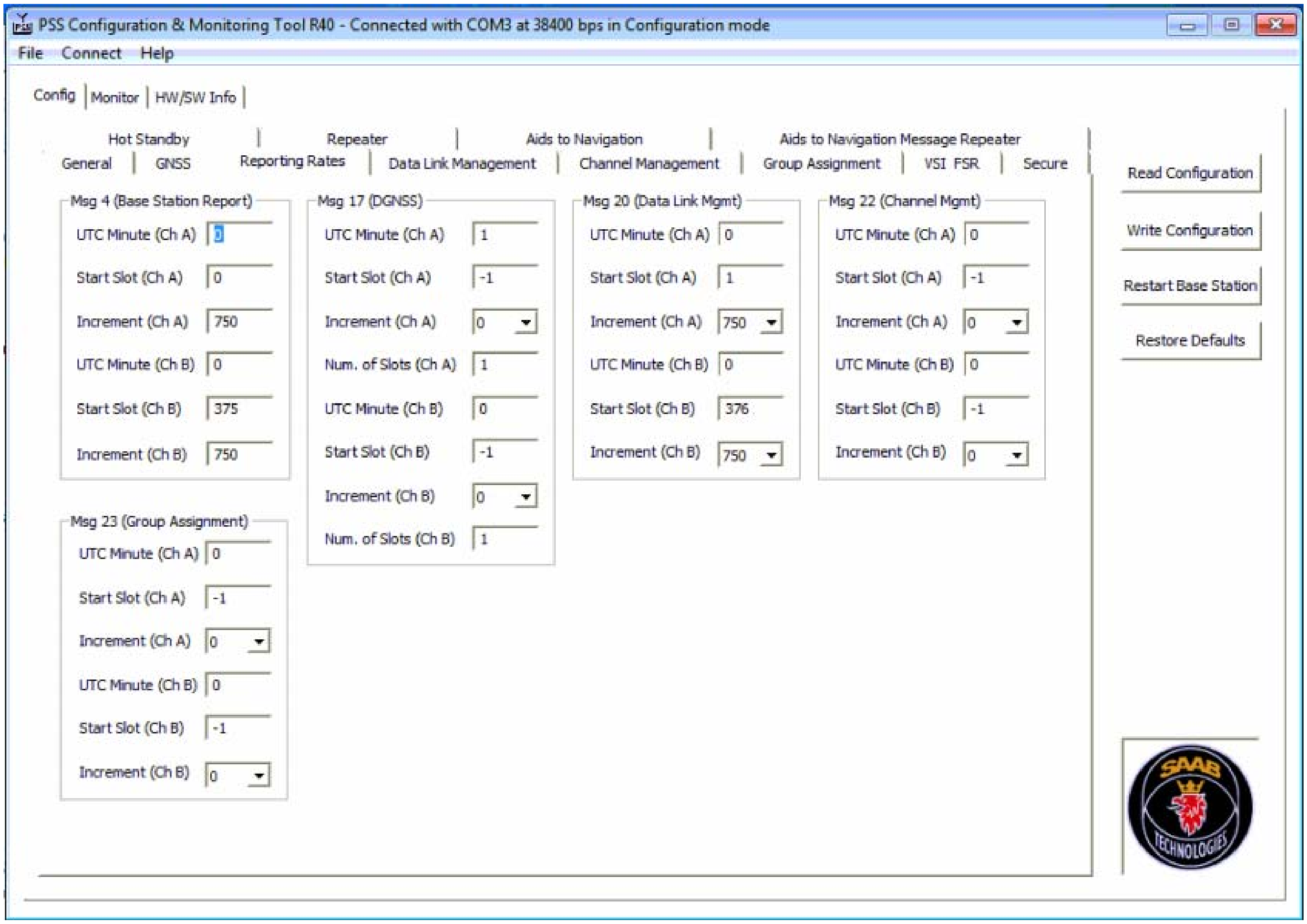

Figure 3. Louisville base station scheduled messages.

3.5 Mariner Software

3.5.1 CEACT

Some of the mariners (Crounse, Marathon Oil) use CEACT (Channel ECDIS, AIS & Course Trajectory) software developed by CEACT Inc. and SevenCs GmbH. They have included the decode and display of the ASMs in their software. A sample display of the CEACT software is shown in Figure 4.

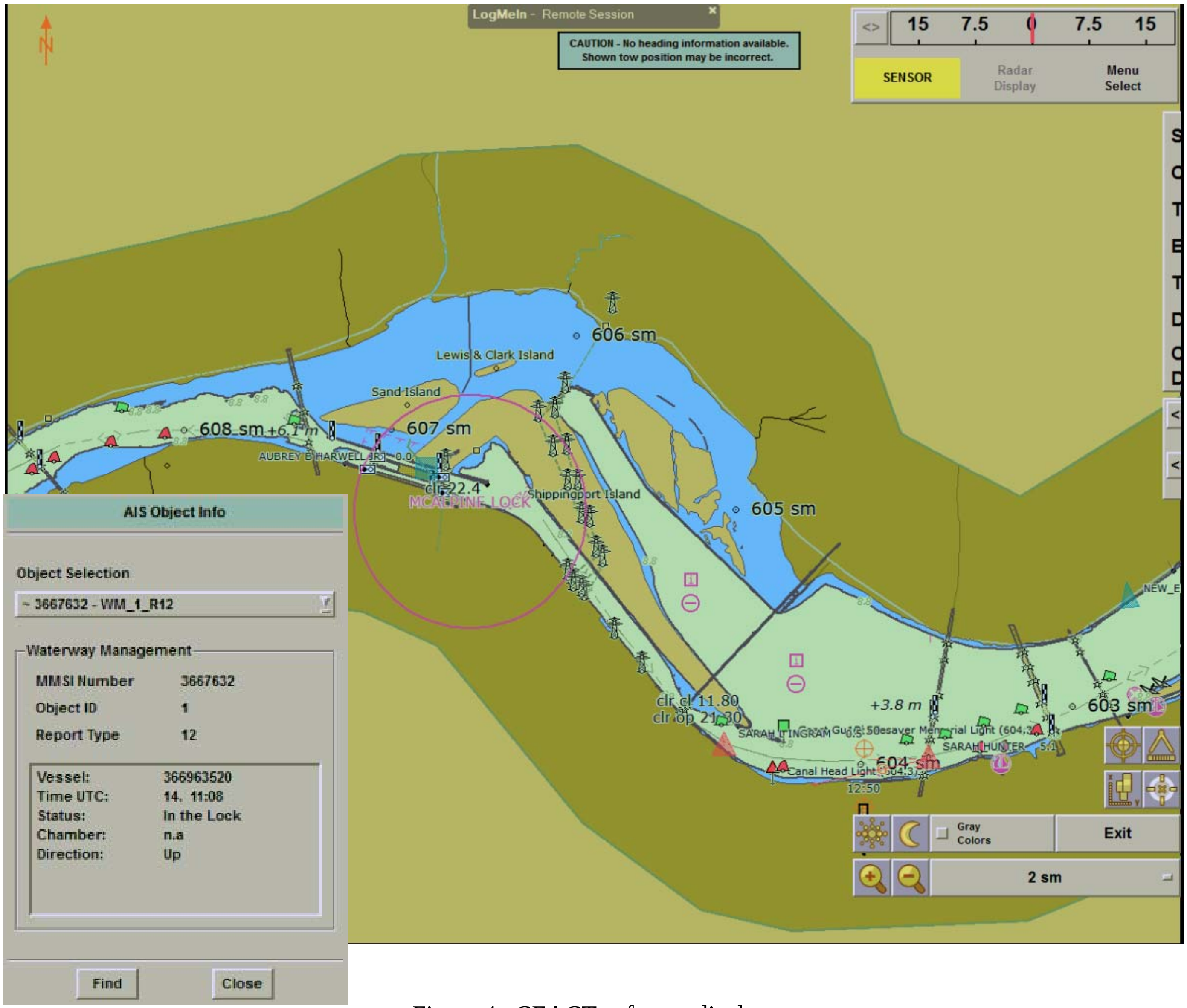

Figure 4. CEACT software display.

3.5.2 RosePoint ECS

Some of the mariners (Ingram Barge and American Commercial Lines) use RosePoint ECS from RosePoint Navigation Systems. A sample display from the RosePoint ECS is shown in Figure 5. According to RosePoint, the latest version was distributed in December 2013. This version includes the decode and display of the ASMs; however, the user must enable the AIS ASM feature, it is not enabled by default.

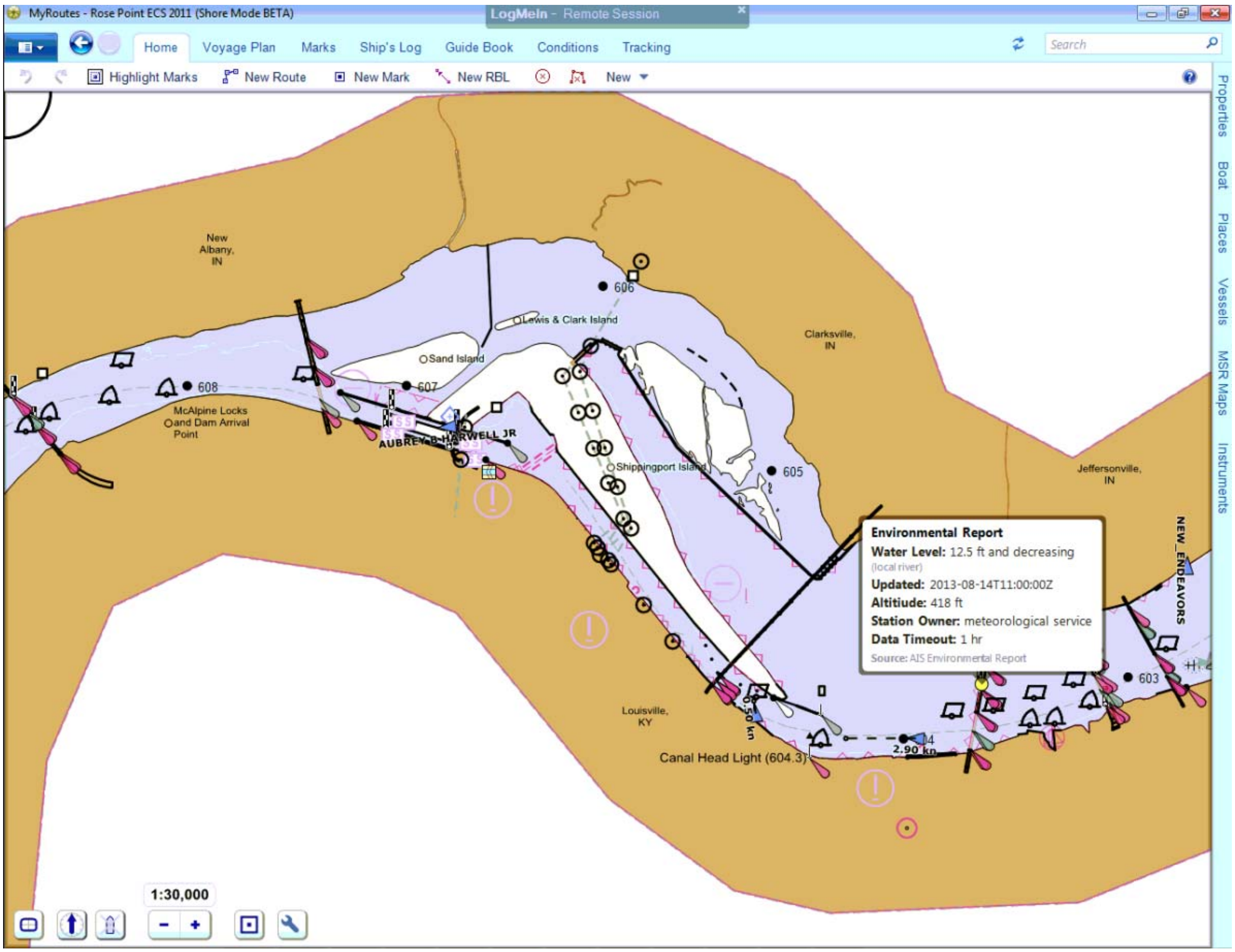

Figure 5. RosePoint ECS software display.

3.5.3 TV32

VTS Louisville and RDC use the Transview (TV32) software developed by the Volpe National Transportation Systems Center (NTSC). A sample display from TV32 is shown in Figure 6. This software was modified for RDC to decode and display the ASMs.

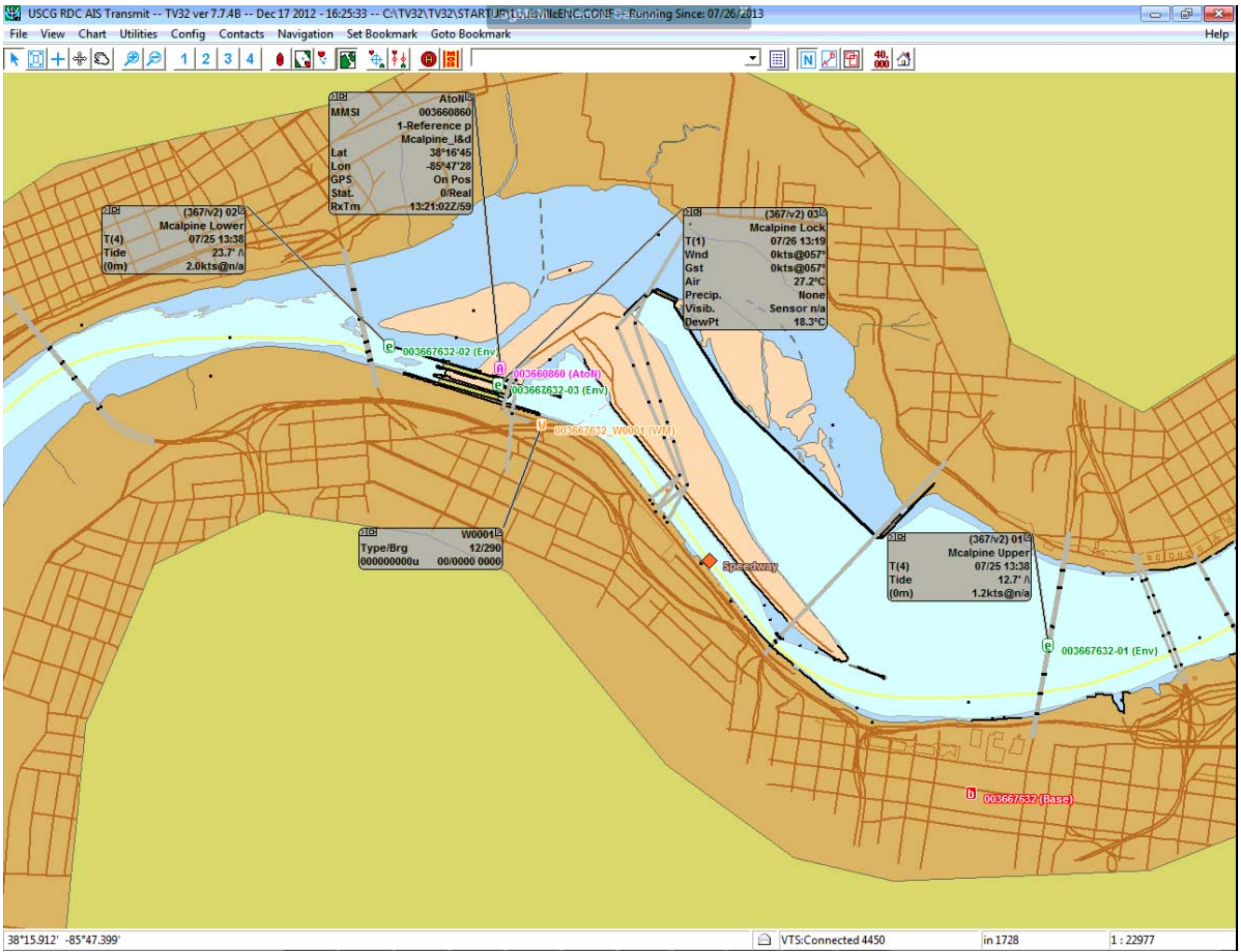

Figure 6. TV32 software display.

3.6 Data Collection Procedures and Responsibilities

Data were collected during the life cycle of the test bed. This data were used to assess the usefulness and effectiveness of the electronic Marine Safety Information (eMSI) for the mariners and to evaluate the overall performance of the eMSI project. This data were also used to assess achievement of the specific goals listed above. A large part of the assessment was based on feedback and usage results obtained directly from the VTS operators and end-users (tow boat Captains). At the beginning of the test, it was planned to collect feedback using surveys; however, it proved difficult in practice to get the mariners to complete them, so feedback was obtained during face-to-face meetings where they were asked a standard series of questions. The following sections describe the responsibility of various groups of participants.

3.6.1 Mariners

- Use the AIS data in onboard ECS software as much as possible when operating in the vicinity of the Louisville transmitter.
- Notify VTS Louisville of any problems experienced with the transmissions.
- Notify ECS vender of any problems with message display.
- Participate in meetings with RDC after two-to-three months.

3.6.2 VTS Louisville

- Observe data broadcasts, notify RDC (irene.m.gonin@uscg.mil) and Alion (gwjohnson@alionscience.com) if the broadcast software stops working.
- Receive trouble reports from the users; resolve locally if it is an AIS transmitter problem, or relay the issue to RDC and Alion if it is a software problem.
- Participate in meetings with RDC after two-to-three months.
- Handle trouble reports from mariners not participating in the test. Forward information to RDC/Alion.

3.6.3 RDC/Alion

- Receive trouble reports and resolve within three business days.
- Conduct meetings.
- Observe and evaluate software implementations.
- Collect and analyze data.

In addition to the data captured by the surveys, raw AIS data were collected using the computer located at VTS Louisville. The data were retrieved periodically and analyzed. The data collection was performed in the background and thus did not interfere with or burden any active participant.

4 DATA COLLECTED

4.1 User Feedback Trip 1

During the week of 12 August 2013, team members traveled to Louisville, KY and Paducah, KY to gather input from various stakeholders. Since none of the stakeholders had used the new ECS software with display of the ASMs yet, the discussions focused on what data would be useful. In addition, various portrayal examples were shown to the stakeholders so that they could give their opinions on the various options.

4.1.1 Louisville, KY

While in Louisville, a visit was made to McAlpine Locks to observe lock operations and discuss the AIS transmit project with the lock operators. The lock operators explained the operations of the lock and how specific data are entered into LPMS. Currently this is a manual process. The dam gate information is also recorded manually, primarily on a paper log. A discussion ensued about AIS and the AIS transmit project with emphasis on ways to collect and broadcast the data available to the lock operators. Currently, the lock operators spend a bit of time on the radio with the tug captains relaying information about gauges (water level) and gate settings (river flow). The lock operators are interested in seeing vessel reports (via AIS) out about 10-20 miles so they can know who is three to four hours out from the lock.

4.1.2 Paducah, KY

While in Paducah, a visit was made to Ingram barge. Mr. Mark Stevens (who has since retired) and Mr. Mike Hatton explained the barge operations from the operator's perspective. The team members were also able to ride out to one of the tugs (*Daniel P. Mecklenborg*) while it was underway. While on the tug, they were able to talk to the tug's two captains (Capt. Dan Hogg and Capt. Mike Holly) and get their opinions on what data would be useful to a tug captain while in transit. They were then taken to The Seamen's Church Institute (SCI) also located in Paducah. SCI promotes the safety, dignity and improved working environment for the men and women serving in North American and international maritime workplaces. Founded in 1834, the Institute is a voluntary, ecumenical agency affiliated with the Episcopal Church; they are also the primary training facility for inland waterways. Most major tug companies use SCI as a training facility, many providing experienced instructors themselves.

A brief tour was given of the training facility. After the tour, a few tug captains were willing to engage in a discussion about the AIS transmit project. Two of the captains were Capt. David Williams and Capt. Spencer Kennedy. After leaving SCI, the team members went to Crounse Inc. and met with Capt. Randy Bowen. Once again, the conversation was centered on the AIS transmit project and what data would be useful to the river tug captains.

4.1.3 Feedback Results

The following is a synopsis of the discussions with tug management and tug captains:

- Water level information– as specified by the pool gauges is important; especially the lower pool.
- Information on the river flow over the dam is extremely important (this influences the strength of the current flow towards the lock wall). This is usually stated as feet of gate opening (Ohio River) or flow in cubic feet per second (Tennessee River). There was a strong consensus from all the captains that the data point, which is most useful, is the total flow (either cubic feet per second or feet of gate opening).
- Knowing the flow at the three locks ahead is also very useful, especially in the places where the locks are close together. This allows them to plan their voyage more efficiently.
- Wind is important but not vital; it is more of a "nice to have" since the current is a bigger factor and once inside the lock wall, the wind typically drops off. Placement of the wind sensor is also important. Knowledge of wind information that is not near the lock has very little value to the tug operators.
- Any general hazardous condition that is known should be transmitted. An example would be a submerged object or a high sandbar that is not on the chart. If they could see it on the electronic chart as a virtual target, they could avoid it. It only takes one incident to severely hamper their operations.

- The lock status would also be very valuable for them to know; whether a lock is broken, being repaired, is about to be taken out of commission etc.
- Vessels in queue and queue order are very important. Not only for the next lock but a "look ahead" to the next two or three locks would greatly benefit the tug operators with regard to planning and selection of speed.
- Although much of this data are posted on the Internet, Ingram stated that cell coverage is only available about 43-percent of the time plus then it is only available on a separate computer; having all of the information integrated onto the ECS would be a huge benefit to them.
- RDC/Alion has followed up with the key tug POCs to solicit feedback and see if the information is being displayed on the charting software displays. This feedback is very difficult to obtain due to the nature of the tug business. Tug captains are underway for 28 days and then are off for 28 days. They are difficult to communicate with while underway and difficult to contact when they are off.

4.2 Kongsberg Discussions

On 26 September 2013, team members had a phone conference with Herbert Taylor (VP Operations, Kongsberg Maritime Simulation Inc.) to discuss the integration of AIS data in the ships simulator at Seaman's Church Institute. This discussion continues. Both SCI and Kongsburg are willing to achieve this goal, however the path to reach this goal will most likely be achieved via a "major" systems upgrade. This upgrade is yet to be determined. RDC/Alion remains in contact with SCI/Kongsberg to ensure adequate follow up and keep this issue on the "front burner." Integrating ASM creation and display into the ship simulator used by the inland river captains would provide a controlled environment to demonstrate and train the captains in the use of the new capability.

4.3 User Feedback Trip 2

During the week of 2 April 2014, team members returned to SCI in Paducah, KY to meet with various captains and mates from Ingram Barge Co. Ingram has 450 captains, pilots, and steermen; they have training 15 times a year. At the meeting, the team gave presentations on both USCG and USACE systems and plans to the 23 captains and mates in attendance. Afterwards, the following input was captured at a Q&A session:

- None of the mariners had seen the transmitted information to date.
- They would like to see the current and future values (actual and predicted) – they like the graphs you can get on the Internet from ORFC.
- They would like to see the AIS data in a side panel (RosePoint does this now).
- They want to keep physical AtoNs as they believe that they are important; they use the visual (real) aids for flanking (passing).
- They need quicker chart updates/buoy discrepancy reports.
- Virtual aids on bridge abutments are ok, "can't hurt," but may not solve all of the collision problems.
- They would like to have gate/discharge information.
- The Vicksburg and Upper Baton Rouge bridges were mentioned as critical points.
- The Yazu River was also mentioned as it can cause eddy currents that are troublesome.
- They would like wind and water current readings at bridge abutments.
- In the lower river they want current velocity – tends to set tows against the wall.
- Air gap was also desired – all bridges – all navigable spans – and needs to be precise – sometimes 6-inches can be important. I-10 was specifically mentioned. All spans are important because to help with congestion they sometimes use other spans besides the primary.

- Lock info desired: gate settings, operational status, discharge, restrictions, and changes in policy/procedures.
- They need information on the Cumberland River (especially near Clarksville); they need to know which span to use, clearance and water level are both important (right now, they rely on some local landmarks).
- Current modeling – would like distance from the wall that the current starts to turn perpendicular (outflow) for Markland and Greenup in particular at certain river stages, Cannelton and Newburg too.
- Water currents around bridges are also a concern – can these be modeled?
- Chain of locks canal mentioned as a key area, also Lock 2 in Arkansas.
- Recommended to start with top-ten in each River – get “key” locations from mariners. For example, Cincinnati is key for Ohio.
- ORFC data are good – like the river up/down graphs.
- AIS is good for consolidating data in one place vice the mariner having to go to four-to-five different web pages.
- Need to coordinate with TVA – they have info – need to resolve datum issues though.
- Concern about Cheathum lock – getting sensor data from Clarksville vice the lock?
- Another message idea would be flushing drift notice.

4.4 Summary of AIS Data

A snapshot of the data being transmitted (and received) from the Louisville AIS base station is shown in Figure 7. Data are shown for the first three weeks of August 2013.

4.4.1 Received Data

As expected, most of the received traffic is AIS message 1 (ship position report). These ranged from 78,000 to over 140,000 per day. However, to put this in perspective, all of the traffic sent/received at Louisville amounts to only about 2-percent of the maximum possible on the VDL. AIS Message 3 (special position report) ranged from 1,000 to about 2,400 and AIS Message 5 (static and voyage related data) ranged from about 2,100 to 3,800 per day. There are also from 700 to 2,200 AIS Message 18 (Class B position report) and from 500 to 1,400 AIS Message 24 (static data report – name for class B’s) received per day. An average of 478 AtoN reports per day are received from the AIS AtoN unit located at McAlpine Lock. This unit transmits every five-minutes so there should be 480 messages per day. An average of two messages per day (0.4-percent) are currently being lost – probably because the AtoN unit is configured for RATDMA mode. There were also four days when AIS Message 8 (broadcast binary message) were received; these are USCG encrypted AIS messages (DAC 366 FI 56 and FI 57).

4.4.2 Transmitted Data

As of August 2013, the shore side system was configured to generate the following types of ASMs for the McAlpine, Markland, and Cannelton Locks:

- Environmental ASM containing pool gauges, wind conditions, and weather conditions,
- Environmental ASM containing predicted river flow,
- Waterways management ASM containing lock queue information, and
- Linked text ASM containing vessel names when the MMSI is unknown.

This information was generated at three-minute intervals for all of the information except the river flow, which was at 5-minute intervals. Over the three-week period shown in Figure 7 typically around 5,000 to 6,000 messages (AIS Message 8, broadcast binary message) were sent each day with the high being about 7,400 on 15 August. There were two periods (3-5 August and 17-19 August) where there were some problems with the transmit chain and thus reduced numbers of transmitted messages.

The test bed has been in operation continuously since August 2013; Figure 8 is an update to the message statistics where data from two-to-three days from each month are shown. Typically, around 6,000 to 8,000 messages (AIS Message 8, broadcast binary message) were sent each day with the high being about 8,250 on 19 September. During parts of January there were some problems with the transmit chain and thus no transmitted messages. In November, the AIS AtoN at McAlpine lock was changed to reporting at three-minute intervals (six-minute interval on each channel) for a total of 960 reports per day. It was also changed to use FATDMA slots, with the slots being reserved by the base station. This seemed to improve performance; most of the time all reports were received whereas with RATDMA we typically only received about 99-percent.

The increase in the receipt of AIS Message 8s starting in March was due to the initiation of transmit operations from the USACE AtoN transmitter at McAlpine lock. This data are received by the Louisville base station. The large increase in June was due to turning on messages for several locks in the Pittsburgh area, which initially, due to DataSwitch errors were also being routed to the McAlpine transmitter.

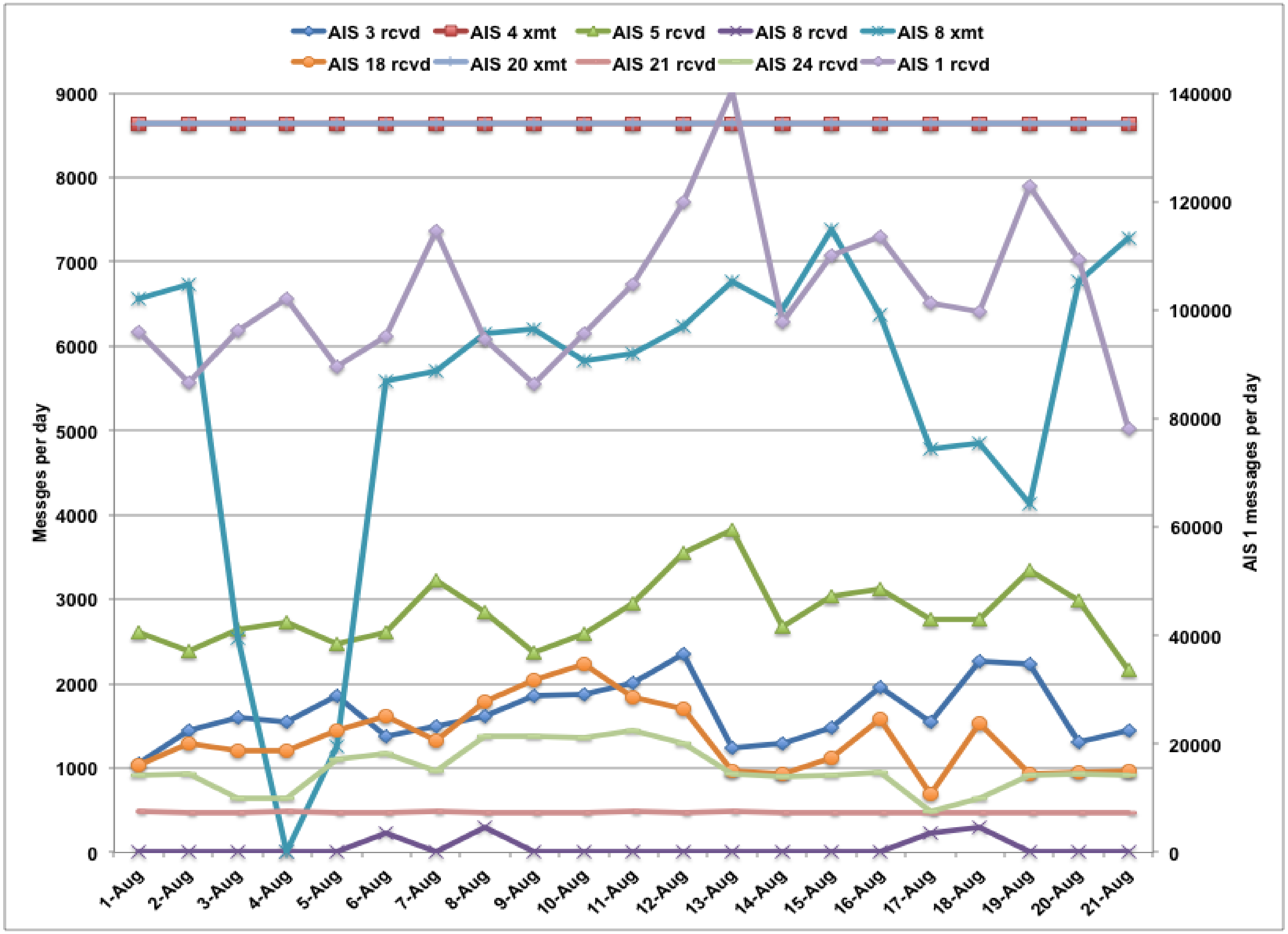

Figure 7. AIS messages sent/received at Louisville, 1-21 Aug 2013. Scale on right is for AIS Message 1, all others are on left.

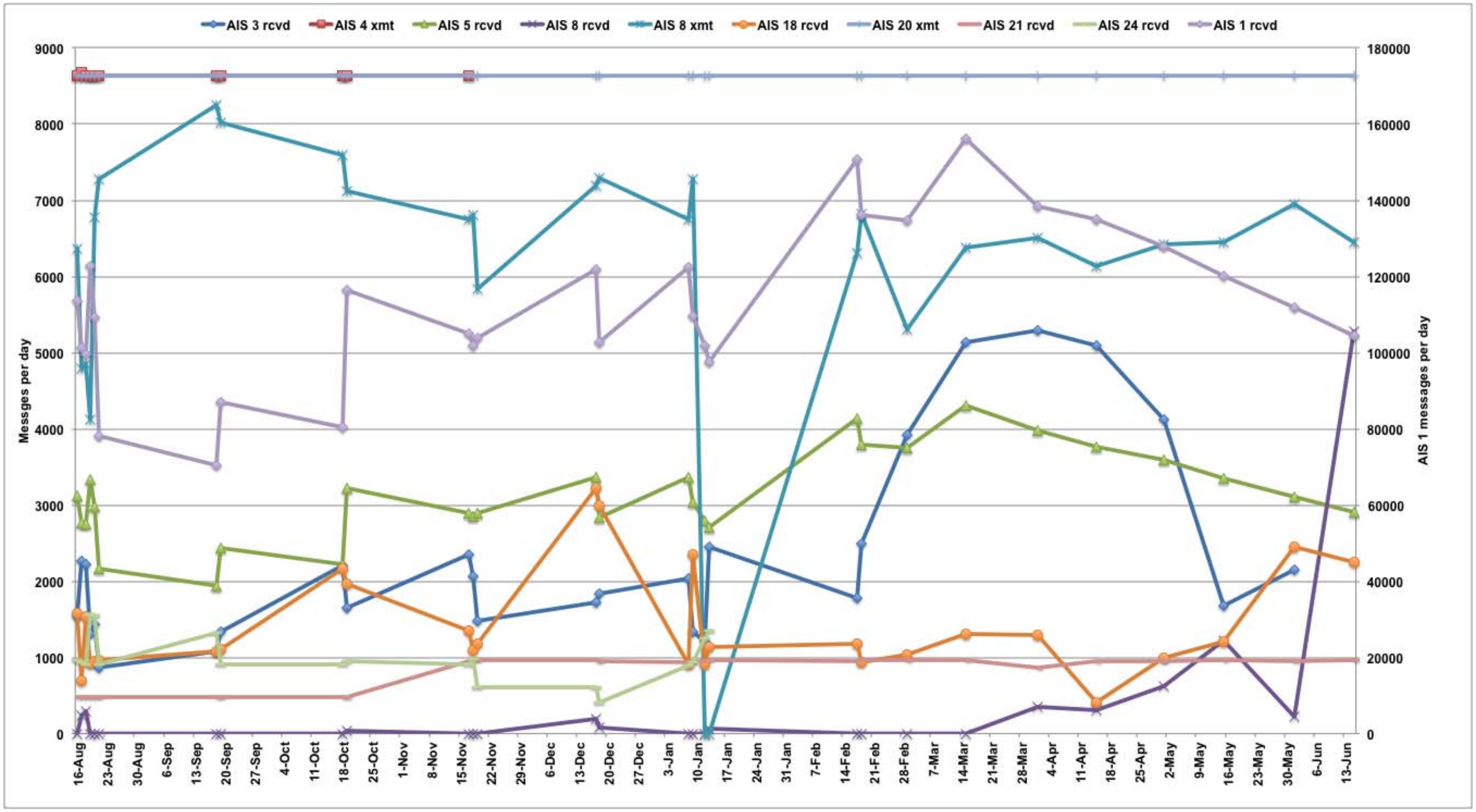

Figure 8. Sample statistics.

5 RESULTS/CONCLUSIONS

From the transmit side, the test bed worked well. The system was operational the majority of the time, with only minor downtimes due to computer or network problems. The automated processes to grab, format and queue the data for transmission all worked well.

From the receive side, it proved difficult to collect a lot of feedback from the mariners. The only feedback received was from meetings. This was effective, but time-consuming for project personnel. By meeting with the mariners in Paducah while they were undergoing training at SCI, a large number of captains were available at once. The meetings revealed that the information from ASMs contribute to navigation safety. The information also aids in planning their transit on the rivers to improve transportation efficiency.

In addition, even though a large number of the test participants had RosePoint software as their ECS, many were not familiar with the AIS ASM features due to lack of training. The simulator at SCI has RosePoint as the ECS system in all four of their bridge simulators. Since all of the barge companies send their captains through the simulators regularly, this offers an opportunity to work with SCI to include the ASMs into the scenarios and thus provide a controlled environment to train the captains on the use of the ASMs and also garner their feedback. This opportunity should be investigated.

As the Louisville test bed transitions into being part of the electronic Aids to Navigation (eAtoN) Joint Technology Concept Demonstrator, there are a several items that should be included:

- The storm cell warning generation should be used to offer some automatic Geographic Notice ASM generation.
- The base station should be configured to generate AIS Message 23 (group assignment) for an area around the lock – this will force all vessels in or near the lock to generate position reports at a faster rate.
- Some data should be collected from vessels to see how far up and down the river the messages are received – both from the base station and the AIS AtoN transmitter.
- Seaman's Church Institute and the workboat community would greatly benefit from the integration of AIS ASM data in their simulation models. This may require cooperation and co-development of canned AIS ASM data that the simulator can use in its various training scenarios.
- An increase in the transmission coverage area will help; currently mariners only receive the information when operating near Louisville; this limits the number of mariners exposed to the data transmissions.
- Increase training of mariners so that more of them will be aware of the increased functionality with their electronic charting systems.
- The Mississippi DOT Bridge Project has a grant for work; it might be possible to tie into this project for data and for transmitter locations.